

MRI is a Feasible Alternative to Arthrogram and Spica Cast Change in Closed Reduction Treatment for a Developmentally Dislocated Hip

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INTRODUCTION:

Following closed hip reduction with spica cast immobilization for a dislocated developmentally dysplastic hip (DDH), arthrogram and cast change have traditionally been performed under anesthesia at the midpoint of casting, typically around 6 weeks. Following development of a rapid sequence MRI protocol, many surgeons at our tertiary care referral center transitioned to awake MRI at the midpoint of casting instead of arthrogram and cast change under anesthesia. Utilizing this protocol has attractive features, including reduced anesthetic exposure.

The aims of this study were to evaluate the feasibility of an in-cast MRI vs. arthrogram and cast change under anesthesia at the midpoint of spica cast treatment, and to compare features of each treatment pathway. The primary outcome was mean anesthetic time for intervention/evaluation at casting midpoint. Secondary outcomes were rates of postoperative complications including reoperation, skin irritation, femoral nerve palsy and proximal femoral growth disturbance.

METHODS:

ICD-10 diagnoses codes were used to identify patients with DDH who underwent closed reduction between 02/01/2016 – 12/31/2022. Patients were excluded if they were ≥ 2 years of age at the time of index procedure, presented with teratologic dislocations or underlying neuromuscular conditions, had < 1 year clinical follow up, or failed closed reduction intraoperatively and went on to open reduction.

Demographic data included sex, race, ethnicity, and age at the time of closed reduction. Severity of dysplasia preoperatively was classified by the International Hip Dysplasia Institute (IHDI) classification system. Data extracted included anesthetic time for the midpoint intervention/evaluation. Anesthetic exposure time was calculated as the time between induction and removal of airway. Acetabular indices (AI) preoperatively, at age 2, and at final follow up were recorded. Outcomes included postoperative rates of reoperation, skin irritation, femoral nerve palsy, and proximal femoral growth disturbance. Skin irritation was defined as dermatitis, rashes, erythema, or abrasions resulting from spica cast treatment.

Normality was assessed via Shapiro-Wilk tests. Independent samples t-tests and Mann Whitney U tests compared continuous variables. Pearson Chi-Square (with Bonferroni post-hoc analysis for distribution of preoperative IHDI classifications) compared discrete variables.

RESULTS:

Following closed reduction, 9 patients (9 hips) underwent an arthrogram and cast change at a mean and standard deviation (SD) of 43.3 ± 10.9 days, while 9 patients (10 hips) had an awake MRI at 47.1 ± 10.7 days. There were no differences in sex, race, ethnicity, age at closed reduction, preoperative IHDI grade (**Table 1**), or time in spica cast (**Table 2**). Mean (\pm SD) follow up was 2.8 ± 1.8 years for the midpoint MRI group and 2.3 ± 1.5 years for the arthrogram/cast change group ($p=0.447$).

Patients were sufficiently immobilized in their spica casts such that MRIs were completed awake; none required sedation. Patients who underwent arthrogram/cast change were exposed to a mean (\pm SD) 90 ± 9 minutes of anesthesia ($p < 0.001$, **Table 2**). There were no differences in the rates of reoperation, skin irritation, or femoral nerve palsy (**Table 2**). At final radiographic follow up, there were no differences in proximal femoral growth disturbance or AI (**Table 2**).

Patients without cast change spent a mean (\pm SD) 11.3 ± 2.8 weeks in the same cast and none outgrew their casts or required a cast change due to hygienic issues. One patient in the midpoint MRI group underwent a secondary procedure during the follow-up period, a pelvic osteotomy at age 3.

DISCUSSION AND CONCLUSION:

MRI at midpoint of casting may revolutionize the DDH treatment algorithm. The traditional arthrogram and cast change under anesthesia at the midpoint of spica cast treatment following closed reduction may be replaced by a rapid protocol awake MRI in some settings. MRI at midpoint of casting significantly reduces anesthesia exposure, with complications identified in this small series. Success with this protocol requires access to MRI with rapid protocols for DDH and optimal casting materials including waterproof liner and fiberglass, as well as casting techniques to build sufficient space in the cast for comfort, hygiene, and growth.

Table 1. Demographics and Pre-Operative Clinical Features.

	MRI	Arthrogram + Cast Change	P-Value
Age at treatment (years); mean ± SD	0.9 ± 0.4	1.0 ± 0.4	0.466
Female; n (%)	7 (77.8%)	8 (88.9%)	0.527
Race; n (%)			
White	6 (66.7%)	6 (66.7%)	0.721
Asian	1 (11.1%)	1 (11.1%)	
Other/Unknown	2 (22.2%)	2 (22.2%)	
Ethnicity; n (%)			
Hispanic/Latino	0 (0%)	0 (0%)	0.303
Not Hispanic/Latino	8 (88.9%)	9 (100%)	
Other/Unknown	1 (11.1%)	0 (0%)	
Pre-Operative IHDI Grade; n (%)			
II	4 (40%)	2 (22.2%)	0.101
III	5 (50%)	2 (22.2%)	
IV	1 (10%)	5 (55.6)	
Pre-Operative AI	40.4 ± 5.5	42.1 ± 7.7	0.583

SD: Standard Deviation; IHDI: International Hip Dysplasia Institute; AI: Acetabular Index

Table 2. Procedural Characteristics and Post-Operative Outcomes.

	MRI	Arthrogram + Cast Change	P-Value
Anaesthesia time (minutes); mean ± SD	0 ± 0	90.1 ± 9.5	<0.001
Re-Operation; n (%)	1 (10%)	0 (0%)	0.330
Skin Irritation; n (%)	2 (20%)	2 (22.2%)	0.906
Nerve Palsy; n (%)	0 (0%)	0 (0%)	N/A
Time in spica cast (days); mean ± SD	79.3 ± 12.8	81.6 ± 10.3	0.679
Proximal Femoral Growth Disturbance at age 2; n (%)	1 (10%)	2 (22.2%)	0.466
Proximal Femoral Growth Disturbance at final follow-up; n (%)	1 (10%)	2 (22.2%)	0.466
AI at age 2	27.9 ± 5.9	35.4 ± 5.5	0.011
AI at final follow-up	25.8 ± 6.5	30.7 ± 7.3	0.144

SD: Standard Deviation; AI: Acetabular Index